**Reference No.:** 112

**Project Title:** LARC-SI Flexible Multi-layered Electrical Circuitry

**NEPP Project:** Electronic Packaging Project

**Point of Contact:**

Dr. Edward Long
757-864-4249
e.r.long@larc.nasa.gov

J. Otis Riggins
757-864-3807
j.o.riggins@larc.nasa.gov

**Center:** Langley Research Center, Goddard Space Flight Center

**Status:** Ongoing

**Performance Periods:** FY 99 – FY 01

**Benefits**

Non-adhesive, structurally integrated flexible cable/circuit designs are core enablers for meeting low weight/volume requirements for cheaper, better, faster missions into space.

**Partnerships and Endorsements**

1. Enterprises:

Using Existing Developed Composite Multi-linked Polymers to Design Flexible Circuitry for Low Weight and Improved Manufacturability with Improved Thermal and Lower Outgassing Requirements. Provide Electronics Packaging Options for Advanced Flight Deck Avionics (Code R), GAMS (Code Y), Office of Space Science (Code S), PICASO(Code Y), Manned Flight (Code M), X-33 Vehicle Health Monitoring (Code R)

2. Projects:

- Micro ball grid array on flex
- Chip on flex
- MMIC on flex

3. Added value to FBC or Risk Reduction:

4. Inter-Center teaming: GSFC, JPL

5. Industry leveraging: Virginia Power Corporation (LaRC-Si Licensee), Richmond, Virginia: Republic Technology, Charlottesville, Virginia

**Objectives of Proposal Activity:**

To evaluate flexible multi-layered circuitry based on LaRC-SI polymer, which will enable low-cost, non-adhesive system structural integration of micro-electric devices. Evaluation Program will Accelerate new technology through validation, assessment and test methods/tools. Project upon completion will provide NASA Projects with infusion paths for emerging (NASA developed) technologies into flight projects. Qualification report will provide application and selection guidelines for new microelectronic packaging processes. Final report will disseminate quality assurance, reliability, validation, tools and availability information to the NASA and Space Industry community.

**Technical Approach:**

Research and evaluate packaging options best suited to provide flexible multi-layered circuitry based on LaRC-SI polymer. This will enable low-cost, non-adhesive system structural integration of micro-electric devices, and provide increased radiation shielding characteristics, select candidates for space level validation testing, prepare summary reports and make technical and potential vendor/materials recommendations.

This effort will focus on the investigation and evaluation of Non-adhesive, structurally integrated flexible cable/circuit designs which are core enablers for meeting low weight/volume requirements for cheaper, better, faster missions into space. Resources will be employed to:

Publicize the technologies that are seen to have potential application in NASA space flight applications and determine circuit applications to provide proof of concept evaluation and then spaceflight qualification for specific program needs. Devise evaluation/qualification plans for space flight applications. Partner with the supplier and industry in the development and evaluation phases. Develop key reliability, quality and performance characteristics essential for procurement specifications for space flight parts utilizing promising technologies. Promote use of these new technologies into NASA program. Several space flight projects now in the early design phase wish to use advanced flexible circuit designs and materials in different applications. These projects need the space and weight savings to be provided by these types of packaging devices. No previously qualified suitable devices exist to meet these design mission requirements.

**Deliverable and Milestones:**

- Description of products: Characterization of LaRC-SI flexible film for multi-layer circuitry for space applications (FY99Q2)
- Flex cable integrated with high density micro connectors (FY99Q3)
- Perform Radiation induced arc-tracing tests (FY99Q3)
- Outgassing measurements of multi-layer film (FY99Q4)
- Hidden (blind) Via qualification (FY00Q2)
- Process evaluation of LaRC-Si flexible fabrication techniques (FY 00Q2)
- Characterization of multi-layered circuit performance (FY00Q3)
- Design guidelines for material use for TDR susceptibility (FY00Q4)
- Temperature extreme testing of flex (FY01Q1)
- Near term marketing to the user commercial public sector (FY01Q3)
- Inspection methodology and acceptance/rejection criteria ( FY01Q3)
- Materials added to the NASA Qualified Materials (FY01Q4)
- *Qualification report from LaRC*
- *Annual status reports*
- *Report on project/device development tools used*

**Schedule:**

| | Activity |
|---|---|
| 1FY99 | Project Scheduling |
| 2FY99 | Test Samples Acquisition |
| 3FY99 | Radiation Exposures |
| 4FY99 | First Year Report |
| 1FY00 | Flex Circuit Testing and Characterization |
| 2FY00 | Environmental Testing |
| 3FY00 | Data Collection |
| 4FY00 | Second Year Report |
| 1FY01 | Reliability Assessment |
| 2FY01 | Marketing Flight Projects/Industry |

| | |
|---|---|
| | Coordination |
| 3FY01 | Qualification Plan |
| 4FY01 | Final Report |